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ABSTRACT

High quality evaluation research has demonstrated that smaller classes with a heterogeneous student composition can increase academic achievement and close the achievement gap. Research suggests that changes occur in the classroom naturally as a result of smaller size without efforts by teachers or students to do anything different. With fewer students, teaches understand students better and use more tailored approaches to individuals. Students form closer relationships with classmates and teachers, and the atmosphere becomes more friendly, cohesive, and less regimented. Still, researchers also observe that some changes, such as the use of more hands-on activities, emerge gradually, perhaps as teachers learn more about what is possible, and that individualization may not always be done well. Evaluation research has been slow to address potentially appropriate staff development training that may enhance the experience of smaller classes. The few existing evaluation studies have not shown any benefits from training. At present, there is no agreement on the usefulness of staff development or on a general standard of teacher training appropriate for smaller class sizes. (Contains 50 references.) (SLD)

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Research Watch

Evaluation and Research Department

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A Review of the Literature

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WAKE COUNTY PUBLIC SCHOOL SYSTEM

Research Watch

Evaluation and Research Department

E&R Report No. 01.30 July 19, 2001

CLASS SIZE REDUCTION
A REVIEW OF THE LITERATURE

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High-quality evaluation research has demonstrated that smaller classes with a heterogeneous student composition can increase academic achievement and close the achievement gap. Research suggests that changes occur in the classroom naturally as a result of smaller size without teachers or students trying to do anything different. With fewer students, teachers understand students better, they use more tailored approaches to individuals, students form closer relationships with classmates and teachers, and the atmosphere becomes more friendly, cohesive, and less regimented. Still, researchers also observe that some changes such as the use of more hands-on activities emerge gradually (perhaps as teachers learn more about what is possible) and that individualization may not always be well done. Evaluation research has been slow to address potentially appropriate staff development training that may enhance the experience of smaller classes. The few existing evaluation studies have not shown benefits from training. At present, there is no agreement on the usefulness of staff development or on a general standard of teacher training appropriate for smaller class sizes.

Background and Legislation

Parents and teachers have attested to the effectiveness of small classes. After years of debate and speculation among researchers, several high-quality evaluation research studies have found that small classes do result in greater academic achievement. In 1998, Congress responded to the overwhelming research evidence by allocating funds to reduce class size in the early grades through the Class Size Reduction Program. The goal of the program is to hire 100,000 new teachers and reduce class sizes in kindergarten through grade three across the country to an average of 18 children per class. For fiscal year 1999, the first year of this initiative, Congress supplied a down payment of $1.2 billion for schools to hire new classroom teachers for the 1999-2000 school year. Congress justified this expenditure by stating, "class size reduction can be particularly beneficial in early grades because students in those grades are learning to read and to master the basics in math and other subjects." The Department of Education estimated that during the fiscal year 1999, school districts hired approximately 29,000 new teachers from class size reduction funds.

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For fiscal year 2000, Congress increased the funding for class size reduction to $1.3 billion. Congress also put more emphasis on staff development training by increasing the percentage of funds available to school districts for professional development from 15 to 25 percent. This year (2001), the president's budget proposal requests Congress to allocate an additional $450 million in funding, raising the total to $1.75 billion for the 2001-2002 school year.

North Carolina Governor Mike Easley has proposed reducing class sizes in the early grades. However, funding and timing remain uncertain.

Student Achievement

The Tennessee Project STAR is perhaps the most long-term study regarding the effect of class size reduction efforts on student achievement. Small class size initiatives in Wisconsin, North Carolina, and Indiana have also reported pertinent data. A review of the method of implementation and results for each project follows.

Tennessee

The Student Teacher Achievement Ratio (STAR) is perhaps the most comprehensive study to date on class size reduction. Project STAR ran from 1985 to 1989 and involved 79 elementary schools in the state of Tennessee. Within each participating school, children entering kindergarten were randomly assigned to one of three types of classrooms: small with approximately 13 to 17 students, regular with approximately 22 to 26 students, or regular with a full-time teacher aide with 22 to 26 students. Students remained in the same type of class until third grade. Standardized achievement tests were given to all students at the end of each school year.

- Small classes consistently scored significantly higher on achievement tests than the regular classes and the regular classes with the teacher aide.
- The advantage of being in a smaller class was greater for minorities than non-minorities. The improvement for minorities was nearly double that of non-minorities. For example, the advantage of being in a small class for white students was an average of 8.6 points (.15 standard deviations) on the Stanford Achievement Test (SAT) reading scale. In contrast, minorities in small classes outperformed their counterparts by an average of 16.7 points (.35 standard deviations), more than twice the effect size for non-minorities (Finn & Achilles, 1990). This same pattern emerged for all test components that were administered.
- After entering regular size classes in the fourth grade, students from the small classes during K-3 had higher achievement than did those students from regular classes.
- Behavior of small class students was better than their counterparts (in fourth grade) based on teacher ratings on the Student Participation Questionnaire. Small class students were also rated as expending more effort in the classroom and taking a greater initiative with regard to classroom activities.
- Class size reduction students exhibited higher achievement through the eighth grade, although the difference became smaller over time.
- Some follow-up research suggests that students in the small classes were more likely to take college entrance exams.

Wisconsin

The Student Achievement Guarantee in Education (SAGE) program was initiated in 1996 by the Wisconsin Department of Public Instruction. The program provided funds for schools that serve children from low-income families. Target class sizes of 15 were in place in grades K and 1 in 1996-97, grade 2 in 1997-98, and grade 3 in 1998-99. Most classes had 15 pupils and one teacher, while a few classes had 30 pupils and two certified teachers. For the purpose of evaluation, SAGE schools were matched to similar comparison schools that had normal size classes but resembled SAGE schools in socioeconomic status, achievement in reading, K-3 enrollment, and racial composition. Students were given pre and post-tests, which measured academic achievement in reading, language arts, and mathematics. Selected results from Molnar, Smith, Zahorik, Palmer, Halbach, & Ehrle (1999), Molnar, Smith, Zahorik (1999), Zahorik (1999), and Molnar, Smith, Zahorik, Palmer, Halbach, Ehrle (2000) include:

- Classrooms with 30 students and two teachers (30:2) exhibited achievement equal to classrooms with 15 students and one teacher (15:1). However, language arts and mathematics segments of the tests in second grade were significantly higher in the 15:1 classrooms.
- The first year results indicated that SAGE schools showed statistically superior performance on the Comprehensive Tests of Basic Skills (CTBS) than the comparison schools in math, language arts, and total scores.
- Statistical analysis indicated that significant effects of SAGE at the end of the first grade were still present in second and third grades.
- Black SAGE students scored significantly lower on the CTBS pretest than Black comparison students. In spite of the pretest differences, Black SAGE students scored significantly higher than did Black comparison students on the post-test.
- Black SAGE students closed the achievement gap by achieving greater gains on the CTBS total score. Black students in comparison schools achieved smaller gains than did White students, widening the achievement gap.

North Carolina

Another recent program to reduce class size occurred in Burke County, North Carolina. The class size reduction initiative began during the 1991-1992 school year with a pilot study in first grade classrooms in four schools. In later years, the class size reduction project was phased in to include all first, second, and third graders. The program's goal was to reduce class size to less than 18 students per teacher in these grades.

- The small class students significantly outperformed a matched set of control students in both math and reading at the end of first and second grades.
- The small class students continued to show significant gains as compared to the comparison group in third grade.
- Upon returning to larger classes in the fourth grade, students who experienced smaller classes from first to third grade continued to outshine their counterparts in reading achievement.
- Classroom observers noted that class time devoted to instruction increased from 80 percent to 86 percent, and time devoted to non-instructional tasks such as discipline decreased from 20 percent to 14 percent (Egelson, Harman, & Achilles, 1996; Egelson & Harmon, 2000).

Indiana

Prime Time began in 1984 by reducing first grade classes. Second and third grade classes were reduced in later years. The first grade classes experienced an average decline in class size from 22 to 19 students. The average decrease in second grade class size was from 21 to 20 students. The implementation of class size reduction in Prime Time was not closely monitored, and the results were unclear at times. A class size of 18 students was seen as the target, however class size ranged from 12 to 31 students. Researchers evaluated the Prime Time project by analyzing 10 school district's achievement scores for reading and mathematics. Pre- and post-mean achievement scores were compared for first and second graders.

- Analysis of student achievement data indicated that first grade students in smaller classes showed the most improvement in reading. Of the districts sampled, 50 percent of the first grade students had significant improvement in reading, while 30 percent of the students had a significant improvement in mathematics. The percentages dropped for second grade students to 20 percent making significant improvement in reading, and 10 percent making significant improvement in mathematics (Mueller, Chase, & Walden, 1988).
- Second grade student growth was not as pronounced as it was for first grade students (Mueller et al., 1988).
- Any significant gains that were observed in small classes in the first and second grade had disappeared by grade 3. The researchers concluded that this pattern of results suggests that the effectiveness of class size reduction may be limited to early primary grades (Tillitski, Gilman, Mohr, & Stone, 1988).

Smaller Classes, Pull-out Programs, and Homogeneous Groups

The recent high-quality evaluation research on smaller class sizes (just reviewed) focused on reducing the size of the ordinary classroom with a heterogeneous student composition. Small group remedial instruction for students performing below grade level can be an effective strategy but it is not the same as class size reduction. The finding that smaller classes are especially beneficial for students at risk does not imply that putting 15 at-risk students in one class will help. For homogeneous groups of at-risk students, research supports the use of brief (20 to 30 minutes) individual tutoring and small group (a maximum of three students) instruction in combination with targeted instruction of groups of 10 to 15 students for approximately one hour per day. (Odden, 1990; Slavin, 1989;1987; Madden, Slavin, Karweit, and Liverman, 1989; Madden & Slavin, 1987). These are strategies that can be useful within the current accelerated learning program (ALP). The research found that these strategies were more effective than simple homogeneous groups. Smaller classes should reduce the need for such interventions in the long run, especially if they are combined with more effective pre-school programs, but in the near term smaller classes and targeted interventions should go hand-in-hand.

Classroom and Teaching Characteristics

Many researchers have speculated on why smaller classes make a difference. Although the specific manner in which smaller classes improve academic achievement has not been isolated, it

appears that it may be the consequence of the ways in which reducing class size naturally modifies the classroom atmosphere. Research to date has been primarily qualitative, relying on reports by teachers about what happens in smaller classes.

Numerous aspects of the classroom are changed when the class size is reduced. The changes occur as a natural result of decreased size without teachers or students trying to do anything different. Teachers that have been assigned to smaller classes report that the classroom environment is better, and they have more flexibility to use different instructional practices. Teachers also report that they can provide more individualized attention to their students, and spend less time on non-instructional activities (such as taking attendance, collecting and passing out papers, checking papers, and disciplining students) (Mitchell & Beach, 1990; Mosteller, 1995; Kickbush, 1996). Teachers have also reported having more usable classroom space because they were using the same classrooms with fewer students (Egelson et. al, 1996). With fewer students there are fewer distractions, the noise level is lower, and the room arrangements may be more flexible because there are fewer desks. Sage teachers felt that parents may become more involved with classroom activities because of greater parent teacher communication. Some of these 'aspects' may be part of the reason why students in smaller classrooms show greater academic achievement (Anderson, 2000; Everston, 2000; Bain, Achilles, Dennis, Parks, Hooper, 1988).

The general factors may be organized into four categories. The first concerns the techniques the teacher uses to approach the entire class (termed *instruction*). The second, referred to in the literature as *individualization*, concerns how the teacher relates to each student. A third area concerns how students experience the classroom and has been referred to as *student engagement*. A fourth concerns a conceptualization of the basic *causal mechanism* that accounts for why smaller classes result in increased achievement. Pertinent research findings are summarized under each category in the remainder of this section.

Instruction

Bourke (1986) conducted an observational study of teacher behavior. The study examined 63 fifth-grade teachers who taught in natural classes of varying sizes in Melbourne Australia. Bourke found ***that teachers with no special training in a small classroom environment asked more probing questions and provided more 'wait time' after asking questions than teachers in large classes.*** Both of these behaviors have been shown by other research to be linked to higher achievement. Bourke also observed that small classroom teachers showed more whole-group instruction and student achievement was higher. However teachers in larger classes lectured or explained more than those in smaller classes. Teachers of larger classes tended to form groups and students exhibited lower achievement. Grouping actually seemed to require more teacher time because the teacher had to visit each group and repeat instructional directions. In the Success Starts Small project, researchers observed that in small classes the majority of a pupil's time was spent in individual communication with the instructor, while most of a pupil's time in a large class was evenly split between individual and group instruction (Achilles et al., 1995).

Independent case studies of three SAGE schools conducted during 1998-1999 showed that the dominant mode of interacting with students was direct instruction. However, growing use of

hands-on activities was also noted. Increased use of hands-on activities such as manipulatives in mathematics, drama in reading, and other non-worksheet activities occurs in smaller classes because the impediments to their use are not present in reduced size classes. In smaller classes fewer materials are needed, teachers have more time to prepare, misbehavior is less likely, and basic curricula have been covered more expeditiously. However, it may take some time before teachers accustomed to the restrictions imposed by large classes realize the different things that are possible in smaller classes.

Individualization

Several researchers have found that individualization is part of the reason for higher achievement in smaller classes. Zahorik (1999) noted that three things lead to individualization: fewer discipline problems and more instructional time, greater knowledge of each student's abilities and personality, and more teacher interest for teaching. Many teachers involved with the SAGE project reported knowing each of their students better, and feeling more competent at being able to keep track of how each student was understanding the current lesson. This understanding provided the teacher with the ability to intervene more effectively to help the individual student make progress. Essentially, the teacher was better able to 'read' the students, and immediately address their questions. Initial findings for the SAGE project also noted that both 'average' students and students at risk received comparable amounts of individual instruction.

The independent case studies of three SAGE schools conducted during 1998-1999 confirm and clarify the empirical SAGE findings about classroom events that were compiled from 1996-97 through 1998-99. ***The conclusion that individualization is the main effect of smaller classes was strengthened***. All of the teachers involved voiced this opinion and extensive individualization was witnessed during every visit to the three schools.

The individualization of teaching techniques is procedural rather than substantive. It is, as one teacher remarked, "tailored instruction." Students were neither permitted to pursue their own interests nor were they provided with a personalized curriculum that varied from the established curriculum. All students learned the same content and skills, but they learned them at a different pace and in a different way. As the teachers at one school reported, instruction was based on the individual's current level of proficiency. It built on what each student presently knew how to do.

One-to-one tutoring took place in reduced size classes both for short periods as the teacher monitored an activity and for longer periods when a problem was encountered. In apparent contrast to the findings of the study by Bourke (1986), the dominant mode of individualization was fluid, homogeneous, small groups led by the teacher. The reading and mathematics lessons were usually taught according to a common format including a total class overview, orientation, or directions and then arrangement of the class into groups monitored or taught by the teacher as well as teacher aides or volunteers. With groups of three or four, each student could participate actively. Students could raise questions, make comments, show work, receive feedback, as well as rethink and revise ideas.

What appears to happen to teachers with reduced size classes is that they develop a different mind set. Instead of viewing their pedagogical world as one class of 25 students, they view it

more as 15 classes of one student. Given the speed with which teachers adapt to teaching reduced size classes, it appears that this state of mind has been present all along but made dormant by the stress of large classes. Once this state of mind is activated, it pervades all facets of reduced class size teaching. Even when the class of 15 students is taught as a whole, each student is heard and each receives a "tailored" response.

The 1998-99 case study data also support the conclusion drawn from previous SAGE data that individualization is related to increased knowledge of students, to reduced discipline, and subsequently, more instructional time, and to greater enthusiasm. Teachers reported that they know their students both academically and socially much better which results in a more personal, relaxed, family-like classroom atmosphere. They also said, and observations substantiated, that classroom time was totally devoted to teaching because discipline was generally not needed. Discipline problems decline in smaller classes, not only because inappropriate behavior is instantly recognized in a small class and can be given a response with no delay and because teacher-student proximity reduces its occurrence, but because in a smaller class inappropriate behavior is redefined. As several teachers revealed, in a small class students are given more freedom. Many behaviors not tolerated in a large class because of the disruption they create, such as walking around the room, may be acceptable in a small class. Further, there is also less misbehavior because students' greater understanding in small classes causes them to be less confused and, consequently, better behaved. With respect to teacher enthusiasm, the case study teachers, as did SAGE teachers from prior years, indicated that the smaller classes and the student progress that they saw energized them and caused a great deal of satisfaction and excitement regarding teaching.

Consistent with previous findings, the SAGE case study teachers reaffirmed that the effect of reduced size classes and individualization on students is increased learning. Teachers reported that more content, including content designated for the next grade level, and deeper content were acquired by students. Other outcomes include critical thinking, independence, and social responsibility, as well as enthusiasm for school and improved attendance. The personal and social effects occur because of the family-like environment and individual attention that exists in the smaller classes. Students are freer to express themselves verbally and physically, they help each other as they observe the teacher helping them, and they see their ideas as having worth when the ideas receive attention from others. A teaching team, new to SAGE at Meadow View School, reported that they thought team-taught, smaller classes caused students to become more dependent. This could be seen as a sign of the success of individualization rather than an undesirable outcome. That is, reduced class size students learn to speak up and ask for help when they have a problem or share an achievement about which they are excited rather than to remain silent. Their actions could actually signal that they have become more independent, rather than more dependent.

Most SAGE case study teachers see reduced class size as benefiting all students, but they commented on its particular benefits for special education students. They suggest that the individualization that it causes may prevent future need for special education for some students, spare early labeling for others, and, for those already diagnosed, increase the time they spend in the regular classroom. Simply stated, the teachers believe that the needs of all students can be more easily met in the reduced size class.

Some differences in teaching technique were observed between different types of classes in the SAGE program, but not across grade levels. In terms of subject and grade level, the pattern of teaching in which individualization is prominent does not appear to vary. In terms of type of SAGE classes, team taught classes share the general profile of all reduced size classes, but they achieve it in different ways to some extent. With two teachers, they are able to do many things simultaneously, such as teaching, monitoring, disciplining, preparing, and evaluating.

Individualization means at least two quite different things. In one sense, common to all researchers, it means being able to develop more individualized or tailored approaches and responses to each student. This is the sense in which a teacher begins to view the class as 15 classes of one student and it is this dimension that appears to occur as a natural result of smaller size. In a second sense, individualization may refer to times when the teacher works directly with one student or a small group and not with the other students. In this second sense individualization can be confused with grouping techniques. Moreover, there is substantial variation in research findings along this second dimension. Bourke observed more whole class instruction in smaller classes although the teachers lectured less than in large classes. The Sage case studies revealed a preference among teachers for individual and small group tutoring during the regular class period. However, the SAGE case study teachers were sometimes talking about having small groups of students work together without a teacher or working with individual students for a few minutes during the time they were working with the whole class. At other times teachers were referring to the use of teacher aids and volunteers to work with groups of students independent of the rest of the class. One of the SAGE observers reported that individualization does not mean that the teacher is spending time working with each individual student to the exclusion of the rest of the class. Such individual work was rarely observed. However, even when the teacher was working with the entire class there was constant individual contact with the teacher. It is only in this way that we can make sense of Bourke's observation that teachers in small classes worked with the whole class more but lectured less than did teachers in larger classes.

That smaller classes bring about a change in classroom events and have an impact on student learning is not in doubt. It is, however, as the principal at Oakdale school remarked, only "part of the mix." Individualization may not always be done well. Moreover, there is considerable variation in teaching techniques in smaller classes. The specific structure and use of groupings, for example, does not appear to be a natural result of reduced class size.

Student Engagement

Finn (1998) explored the possibility that "student engagement" may explain why some students perform well in school in spite of disadvantages, which put them at risk of school failure. Teacher interviews have suggested that small classrooms form a cohesive, friendly environment for students. In turn, students form better relationships with classmates and with their teacher, and thus most become more "engaged" in classroom activities. As a result of this "friendly" atmosphere, high-risk students may experience a feeling of belonging and learn to value the gift of learning. These high-risk students may also feel more comfortable asking questions, contributing to class discussion, and drawing attention to themselves. This phenomenon may

also account for why small classes are especially beneficial in the early grades, when young children are learning how to be students, especially good students. Results from Project STAR and SAGE showed that the largest increase in student achievement occurred in the first year of a student's participation in a small class (Krueger, 1998; Molnar et al. 1998).

Understanding the Causal Mechanism

SAGE researchers suggest that the causal mechanism, which explains why students in smaller classes show an increased rate of learning, may be found in an academic theory known as constructivism. According to the theory, when people acquire new ideas, they either accept them into their present schema, or they expand their present schema to incorporate the new idea. In order for this process to occur, 'articulation' and 'critique' are necessary. Students must verbalize or articulate their understandings as well as their misunderstandings, and they need to receive feedback or critique from teachers and peers in order to expand their understandings of the world. When one student receives feedback, the student must consider the implication of the feedback for his or her own understandings. At the same time, teachers and peers are induced to reconsider the idea and the issue, along with that student, from different angles. When students raise ideas and questions, teachers are induced to broaden and deepen their understanding of individual students, how they conceive of things, how to communicate with them. Smaller classes create a much better opportunity for this process to occur. Students can voice their questions more often and teachers and peers can offer more feedback. The enhanced communication in smaller classes should result in better and deeper understanding of course material.

Staff Development

The fact that some teaching techniques emerge gradually in smaller classes and that individualization may not always be well implemented suggests a role for staff development training. However, evaluation research has been slow to address potentially appropriate training that may enhance the experience of smaller classes.

Only a few articles have mentioned that class size reduction teachers were provided with staff development. Many of these offer no glimpse of the type of staff development that was offered, how they were evaluated, or what effect they had. Furthermore, those projects that have tested the effects of training programs have not found significant benefits from training. Some authors conclude that no training is needed; others argue adamantly that class size reduction and staff development must go hand in hand. Jeremy Finn (1998), in his commissioned paper for U.S. Department of Education, noted that additional research is needed to determine "what sorts of teaching practices should be implemented to take maximum advantage of a small class setting."

The Poway Unified School district in California implemented a class size reduction program, in which staff development was offered to the teachers of small classes (Malone, 1998). The staff development consisted of seven different sessions. The first session began with an overview of research findings about smaller classes, room organization, and management practices. Sessions two through six addressed different instructional strategies for various subjects. The last session concentrated on students with special needs, and how to differentiate teaching styles for different

types of students. However, no research was presented on the effectiveness of the training (Malone, 1998).

A North Carolina study done at Oak Hill Elementary (Success Starts Small) in Guilford County also provided staff development to teachers of small classes. The training included a visit to another county to observe established small classes. Researchers and/or consultants also provided instruction and individualized suggestions to first grade teachers to help them determine better ways to teach in small classes. Based on pre- and post-test observations to the in-service training, there were very few changes in teacher behavior.

The Tennessee Project STAR also implemented small-scale teacher training. A special training course was given to 57 teachers over a three-day period, but little detail was given as to what kind of training was offered to the staff. The classes with trained teachers performed the same as did the classes with untrained teachers (Mosteller, 1995). Achilles (2000), a key researcher involved with Project STAR, states that there is no need for staff development in a well implemented class size reduction program, and there are no data showing that teacher training has much effect on achievement levels in small classrooms (Achilles, 2000 (AERA)).

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